Goals and parameters of nuclear program

The nuclear energy development program which is detailed here is geared to recommitting the U.S. population to a program of city building and urban reconstruction to restore a developing educational system and build centers of industrialization using high-technology industrial processes. The same commitment informs the nuclear export policy of this program. Exported nuclear plants and the industrial and agricultural centers attached to them—termed nuplexes—will form the basis for industrializing the developing sector.

Both aspects of the program are based on the utilization of a mix of nuclear reactors that are either commercially available today or can be reasonably expected to be so in the near future—given the national commitment to develop nuclear as a primary power source.

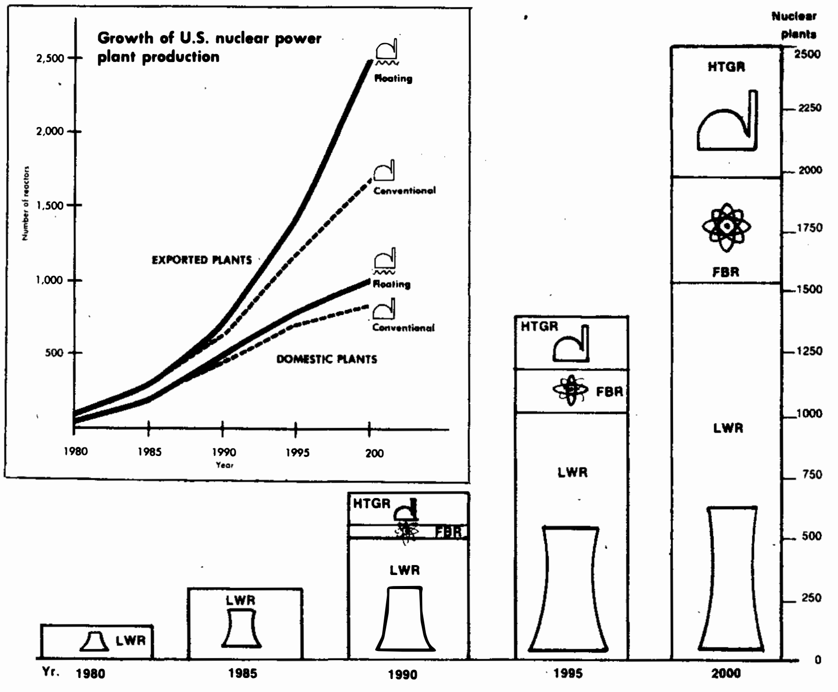
The energy growth that is projected by this program over the next two decades will come largely from the expansion of the production of Light Water Reactors (LWRs), both the Pressurized Water Reactor (PWR) and the Boiling Water Reactor (BWR) types. Such production expansion is only feasible through the institution of standardized designs—a concept recognized as possible, but not yet implemented by U.S. reactor manufacturers.

In addition to the LWRs, two other reactor types are slated for introduction in the 1980s. The High Temperature Gas-Cooled Reactor (HTGR) which can be constructed now, will begin to come on line in the late 1980s. No HTGR reactors of the 1,000 megawatt category exist now because all orders were cancelled during the 1974-75 recession. This reactor type is called a converter and uses fuel more efficiently than the LWRs. It is also very versatile, not only producing electricity by using heat to generate steam for steam-driven turbines. Advanced reactor designs will produce electricity more economically by direct cycle gas-driven turbines, eliminating the steam cycle. Other advanced designs would produce high temperature process heat directly for use in industrial applications in nuplex centers.

The other reactor type is the Liquid Metal Fast Breeder Reactor (LMFBR) which can be expected to come on line at the end of the 1980s, provided the

U.S. nuclear plant production to the year 2000

This chart indicates cumulative production figures to the year 2000, averaging 1,000 megawatts installed electrical capacity per plant. It also indicates what proportion of the total production is made up of Light Water Reactors (LWR), Liquid Metal Fast Breeder Reactors (FBR), and High Temperature Gas-Cooled Reactors (HTGR). The initial trend is for reactors produced in the U.S. to be installed in the U.S. During the late 1980s, nuclear plants and the technology for producing them will be exported.



LaRouche's nuclear development program

- Use the nuclear power development program as the basis for city-building in the United States and in other sectors of the world economy, especially the Third World sector.
- Install 1,000 gigawatts of domestic nuclear capacity by the year 2,000.
- Export 1,500 nuclear reactors of 1,000 megawatt capacity to the developing sector by the year 2,000.
- Create 750,000 high-skilled jobs in nuclear plant construction for American workers by the year 2,000.
- Expand and modernize basic U.S. industry, most immediately the steel and machine tool sectors.
- Implement an oil-for-nuclear-technology trade policy with major Third World nations.

current U.S. program is expanded immediately. The Clinch River Breeder Reactor program must be restarted while at the same time the design of a commercial plant that incorporates the experience of the French Super-Phenix breeder reactor and the U.S. breeder program begins. Incorporating the French designs and results will facilitate meeting the rather stringent schedule laid out in this program for U.S. nuclear power development.

The importance of the breeder program is in the development of a reactor that produces more fuel than it burns and thus can produce fuel for other reactors, both LWRs and LMFBRs. The LMFBR is also a more efficient power producer than the LWR (a 40 percent conversion efficiency compared to about 30 percent for the LWRs) and will eventually replace the Light Water Reactors in that capacity.

In the 1990s, an even more efficient breeder will come on line with the advent of the Fusion-Fission Hybrid Reactor—often called a "fission fuel factory." This type of reactor can produce fuel at three to four times the rate of an LMFBR. A hybrid can be used, therefore, to fuel an expanded LMFBR construction program after the turn of the century.

To meet the production goals set for the next two decades by this program—especially the export requirements—the mass assembly-line production of reactor plants will be required.

The projected mix of reactor types is based on construction capabilities that, although optimistic relative to current projections, are judged to be attainable given a gear-up of the economy and investments. These estimates are based on discussions with experts associated with the production facilities that manufacture the reactors and their components, including those involved in floating nuclear plant construction. Most agreed that these goals could be met by their industry given that the appropriate climate was fostered.

Meeting the nuclear goals

The nuclear energy development program has set as a goal installing 1,000 gigawatts of domestic nuclear capacity and exporting 1,500 nuclear reactors of a 1,000 megawatt capacity to the developing sector by the year 2,000.

siting 500 gigawatts by 1990 so that nuclear represents 55 percent of domestic electrical energy production. Also by 1990, 185 gigawatts will have been exported. By the early 1990s, floating nuclear plant production should be in full gear, correlating with a sharp rise in exports and a tapering off of production for domestic use.

How are these goals to be met?

At present, the U.S. nuclear industry is running at less than 50 percent of capacity. Of the three factories producing reactor pressure vessels, the Babcock and Wilcox plant in New York State has been shut down until orders pick up. Even if the industry were brought to full capacity tomorrow, the U.S. could only manufacture 30 nuclear reactors per year.

The first step in meeting the production goals outlined in this nuclear production program for the United States, therefore, will be to bring the industry to full capacity and at the same time expand existing facilities by 50 percent in the next two years.

In four years, at least one new vessel fabrication plant must be built. The vessel production capacity of these plants can be raised to 45 per year by 1981 or 1982 and to 65 by 1983 if a single plant with an annual output of 20 vessels comes on line. Every succeeding year or two it will be necessary to bring on line another vessel production plant until 20 are in operation by the year 2,000. In the near term, the virtual shutdown of vessel production means that the first few years of the nuclear expansion program will be slower than would be necessary in light of existing production capacity were it being fully utilized.

Initially the

A large proportion of the nuclear reactor output by the year 2,000 will be of the floating variety, both for export and for domestic use. These floating reactors are built on barges at special facilities similar to shipyards

Fabrication and production plant goals for nuclear expansion program

Year	Number of component* fabrication plants (10-20 components/yr.)	Fuel production (metric tons of UO_2)	Number of fuel enrichment plants (2300 metric tons/yr.)	Number of fuel fabrication plants (600 metric tons/yr.)	Number of fuel reprocessing plants (1500 metric tons/yr.)	Number of floating plant assembly sites (4/yr.)
1980	3	3750	2	6	0	0
1985	7	9450	5	16	5	5
1990	9	27,900	12	47	11	17
1995	14	52,650	23	88	25	39
2000	20	90,300	40	151	45	NA

* Includes pressure vessels and steam generators only.

and then towed to their destination along a coastline or in a river. The special advantage of this method of construction is that not only can the plant be constructed in advanced sector countries where the skilled labor currently exists, but also little land-based infrastructure is required to site and utilize these plants in developing nations. In fact, floating nuclear plants can be used to begin development of areas that otherwise would have to depend on labor intensive means of energy production.

Today there is one partially completed floating nuclear plant facility in Jacksonville, Florida capable of assembling four plants each year. This facility should be completed in 1981, with the first four plants floating off the assembly line in 1985. Expansion of this facility and construction of 19 additional plants with larger capacities will meet the requirements of constructing some 950 floating nuclear plants for both domestic use and export by the year 2,000.

These projections are based on considerations that assume that the length of time necessary to construct a nuclear plant can be reduced from the current 10-12 years to six. But this shortening of production time does not take into account the effect of industry-wide implementation of standardization and mass production techniques that have already been introduced by the Soviet Union at the Atommash complex that is in the process of mass-producing nuclear plants. Other new technologies will also affect production time such as the recently announced use by the Soviets of the plasma arc for machining specialty steels used in reactor construction.

To fuel these reactors, more fuel enrichment, fabrication, and reprocessing plants must be built. There are now three fuel enrichment plants. Each plant has a capacity to produce 2,300 metric tons per year of UO_2, the chemical form in which the fuel is fabricated into rods.

The average 1 gigawatt nuclear plant requires a charge of 90 metric tons to start up; 30 metric tons are replaced each year. On this basis and on the basis of the number of reactors projected to be in operation by the year 2,000—both domestic and exported—40 enrichment plants will be required.

Fuel fabrication into the configurations of rods and bundles now occurs at five or six plants each with a capacity of 600 metric tons per year of UO_2. At that unit size, 150 such plants will have to be in operation by the year 2,000.

The Barnwell, South Carolina nuclear fuel reprocessing plant has a potential capacity to handle 1,500 metric tons per year of UO_2. It should be completed by 1981. Best estimates at the present time are that a facility with twice the capacity, or 3,000 metric tons a year, would be optimally cost effective. It will be necessary to construct 17 such plants by the year 2,000 to meet the demand for fuel reprocessing.

The bill of materials

To manufacture 2,500 nuclear power plants by the year 2,000 will demand a full mobilization of existing U.S. basic production plant and equipment and the expansion and growth of basic U.S. industry.

Over 140,000 engineers will have to be trained to

Materials and labor for nuclear construction program

	Steel (mil. tons)		Cement and concrete (mil. tons)	Manpower		
Year	Carbon	Alloy		Total (mil. man-years)	Skilled workers	Engineers
1980	7.0	0.6	15	0.8	158,000	32,000
1985	19.0	1.7	41	2.0	332,000	68,000
1990	45	5.7	136	5.4	454,000	86,000
1995	90	14.4	373	11.4	625,000	114,000
2000	158	25.2	654	19.9	760,000	140,000

all figures cumulative

design, build and staff the nuclear reactors even as standardized design and assembly line production becomes the mode of manufacture. There are now about 32,000 engineers in the nuclear industry. Tens of thousands of highly skilled construction and manufacturing jobs will have to be filled by the next generation of workers, intensively educated and trained on the job to build a mass production industry out of what is now a handicraft.

To build a nuclear power plant requires at least 30,000 tons of carbon steel, 1,700 tons of stainless, and 3,000 tons of other alloy steels. Most projections indicate that the U.S. steel industry will not be able to meet expected demand by the early 1980s. Over 30 million tons of additional capacity will be needed by the mid-1980s just to meet basic demands; more will be needed for the large-scale nuclear program being projected.

The table of total material and labor requirements summarizes the basic inputs, providing cumulative totals to the year 2000 for the 2,500 nuclear reactors slated for production, the fabrication facilities to build the pressure vessels and steam turbine systems for reactor production, and the fuel cycle and fabrication facilities. The amount of steel needed just for this program requires the construction of at least two 8 million ton per year greenfield plants in addition to upgrading and expanding existing capacity.

Specialty steel capacity was significantly expanded in the 1960s in anticipation of an expanding nuclear industry. Much of that capacity is now "excess" and idle. By the mid-1980s additional stainless and other specialty capacity must be on line.

One serious bottleneck to the gear up of basic industry is the machine tool and metal working equipment sector. At present, the lead time for delivery of the most advanced machine tools, such as a computerized boring mill, is two years. New capital goods production technologies need to be introduced to cut these lead times.

Quality control of reactor materials, especially the thick pressure vessels, is now time consuming and adds to the delay of reactor component fabrication. More advanced testing methods, such as X-ray techniques, ultrasonics and dypenetrants, can be applied to quality control in the nuclear industry. Other advanced methods, such as neutron radiography, are now under development.

Without the introduction of computerized and highly automated production technologies, the U.S. will not have enough qualified engineers and technicians to meet a high-technology 7 percent per year growth rate in electricity production. Technologies, like that to be used at the Soviet Atommash facility to produce standardized reactors based on the Henry Ford concept of assembly line production will eliminate the one-of-a-kind engineering requirements of the current U.S. nuclear industry.

The role of nuplex

It is a goal of the nuclear development program to implement an oil-for-nuclear-technology trade policy with major Third World nations and to use nuclear as the basis for building cities in the underdeveloped sector.

Materials and labor requirements per plant

	Materials (tons)					Man-hours	
Type	Steel	Stainless	Alloy	Cement	Concrete	labor	Comments
LWR	47,900	2,030	4,870	59,700	564,000	12 million	for a 1000 MWe plant
FBR	30,700	1,720	3,510	33,400	317,000	14.2 million	
HTGR	73,760	3,192	11,600	49,440	426,400	13 million	
Reprocessing plant	51,400	4,520	7,080	88,000	745,000	16 million	LWR reprocessing 1500 metric tons/yr. capacity
Enrichment plant	331,000	16,400	32,100	120,000	1,200,000	69 million	Diffusion plant, 2,300 metric tons/yr.
Fuel fabrication	22,010	169	304	2,800	27,300	1.3 million	No PU recycle, 600 metric tons/yr. capacity
Fuel fabrication	21,040	60	134	4,025	40,100	1.2 million	With PU recycle, 150 metric tons/yr. capacity
Basic component fabrication plant	30,000 tons of basic structural steel				50,000	3 million	to build all kinds of fabricating plants, i.e., pressure vessels, generators, turbines, etc.
Floating nuclear plant construction facility	40,000 tons of basic structural steel				500,000	70 million	This plant will initially produce 4 1000MWe plants/yr., but later will be expanded to 8 plants/yr.

LWR = Light Water Reactor FBR = Fast Breeder Reactor HTGR = High Temperature Gas Reactor

The nuplex and "Integrated Industrial Complex" is this nuclear power plant of the future, providing energy as heat and electricity to power concentrations of industrial and agricultural processes. The nuplex concept is particularly important for the developing sector where the infrastructure for energy, industry and agriculture does not exist and must be developed from the ground up.

A significant portion of the reactors slated for export from the United States will be, therefore, part of a much larger development package which could include an aluminum production plant, a steel production plant, a synthetic fuel production plant, a chemical fertilizer production plant, and desalination plant, or a combination of these and other facilities. The design of the nuclear reactor or reactors nuplexes will have to be tailored to the type of production facilities to be built and the entire nuplex design must be tightly integrated.

All current reactor designs—the Light Water Reactor, the Liquid Metal Fast Breeder Reactor, and the High Temperature Gas Cooled Reactor—can be used in nuplexes. But the reactor best suited is the HTGR. The most efficient and productive nuplexes can be designed and constructed if a cheap source of high temperature process heat is available with temperatures in the 1400 to 2000 degree Fahrenheit range. The HTGR is the only reactor that can meet these temperature requirements and has been featured in the most recent design of several nuplexes. The lower temperature reactors, like the LMFBR and the LWR, will be able to produce process heat or steam also, but at temperatures of 1000 and 600 degrees Fahrenheit respectively. They can be effectively and economically used in certain types of nuplexes, but they are not as versatile for such applications.

In addition to the higher temperature process heat and steam applications and the production of electricity, the waste heat of all three reactor types can effectively be used in the nuplex as well. This low temperature process heat or steam can be used to desalinate water, heat entire cities, support aqua-culture, provide year-round crops in cold climates, to mention a few applications.

The HTGR has been designed and is currently being developed for nuplex applications by General Atomic Company in the United States and by the West German government. Although these research and development programs have been underfunded during the past 5 to 10 years, it is estimated that given the appropriate funding levels, commercial-size reactors with temperatures in the 1400 to 1600 degree Fahrenheit range could be available for production within 7 to 10 years and could be used in nuplex designs in the 1990-2000 period and beyond.